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AUTOMATIC THERMO-REGULATOR FOR 20° C. INCUBATORS.*

FREELAND HOWE, JR.,
Harrisburg, Pa.

AT the Laboratory of the Board of Public Works in Harrisburg, Pa., we have recently installed, and are now successfully operating, an automatic thermo-regulator for a 20° C. incubator used in the cultivation of ordinary water bacteria. By its use the incubator can easily be kept at a temperature within limits of 1° C. None of the parts of the regulator are new. The method of regulation is simply the conversion of existing devices to a new purpose.

THE PROCESS.

The method consists of the control of the amount of cooled water which flows by gravity through the outer chamber of the incubator. This is done by placing a thermostat of some pattern in the interior of the incubator. When the air in the incubator becomes too warm, the pointer of the thermostat makes a contact with one of the binding posts, thus forming a circuit between a tandem of ammonium chloride batteries and a clock-work motor. When the circuit is thus made, a magnet in the escapement of the motor releases this and allows the motor to make a half turn, thus opening a balanced valve which controls the supply of cooled water, and at the same time, by means of a shunt, throws the circuit onto the other binding post of the thermostat. When the pointer of the thermostat, as a result of the cooling of the interior of the incubator, makes a contact with the other binding post, the motor is again operated, making another half turn, thus closing the valve. This process continues as the temperature of the interior of the incubator changes. The only things necessary besides the apparatus are that the room temperature shall always be as high as 20° C.; that there shall always be a good supply of ice; and that the motor shall always be wound.

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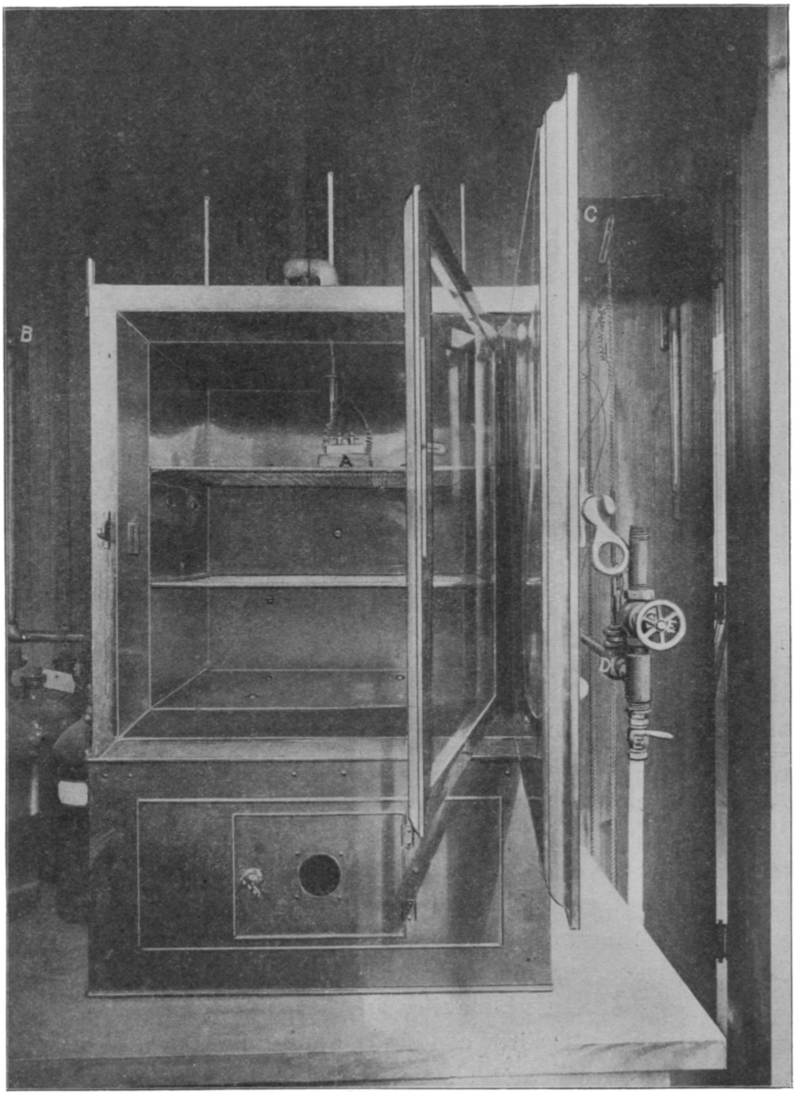


FIG. 1.—20° C. incubator, showing installation of automatic regulator: *A*, thermostat in place; *B*, outlet pipe; *C*, motor; *D*, inlet valve; *E*, valve for regulating quantity of water.

ICE WATER.

The cooled water is supplied by passing water from our filtered water tank through a coil of pipes in the ice tank of the refrigerator used for the storage of bacteriological samples, media, etc. The water is piped to the incubator by a three-quarter inch galvanized iron pipe, along which occur a valve for regulating the quantity of water and a balanced valve which regulates the time at which the water flows. It is necessary to regulate the quantity of water flowing, in order that too great pressure may not exist on the walls of the incubator. The cold water is introduced into the incubator at the top and led away from the bottom. If the cold water should

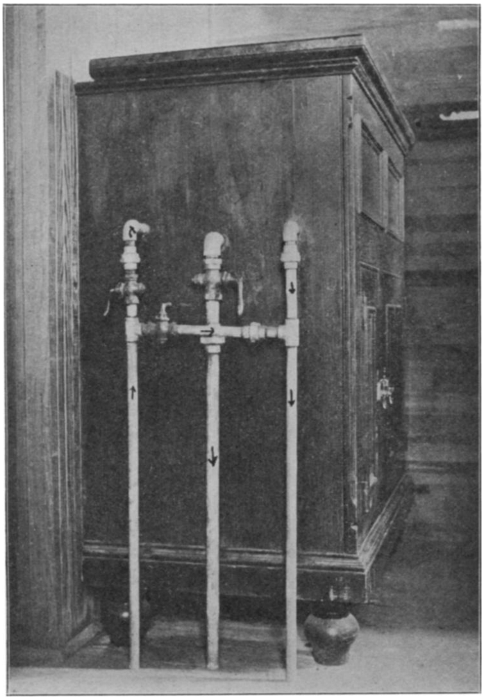


Fig. 2.—Refrigerator, showing piping for purpose of cooling water. Central pipe is only for emptying water from ice tank.

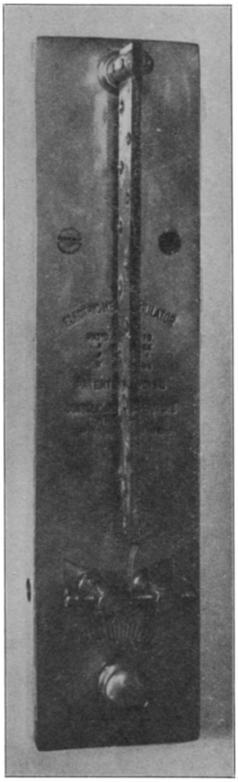
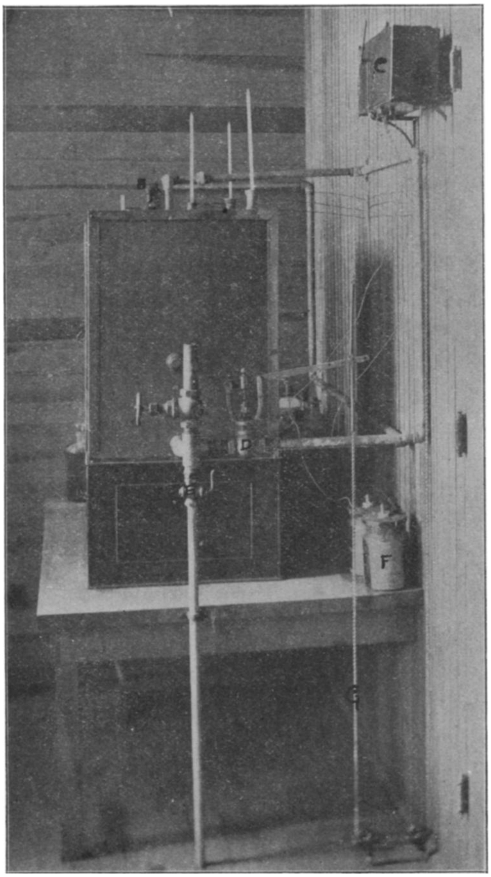


Fig. 3.—Thermostat with expanding bar of hard rubber and brass.

be introduced at the bottom, it would remain there, while the warmer water already in the incubator would be forced out at the top, thus causing the bottom of the incubator to be cool while the top was warm. When the cold water enters at the top, it will naturally pass to the bottom, cooling the warmer water in its passage, thus producing a more even cooling of the interior. There is a by-pass, so that if the water is naturally below 20°



FIGS. 4 and 5.—20° C. incubator, showing thermo-regulator attachments. *B*, outlet pipe (water running in Fig. 5); *C*, mechanical motor; *D*, balance valve; *E*, valve controlling quantity of water; *F*, batteries; *G*, chains between motor and balance valve. (Fig. 4 shows balance valve closed; Fig. 5, open.)

C., it may be passed directly through the incubator without first passing through the refrigerator. The exit pipe from the incubator passes as high as the top of the incubator, and empties into a sewer pipe as an open stream, in order that one can observe the quantity of water flowing, and to relieve the pressure on the walls of the incubator.

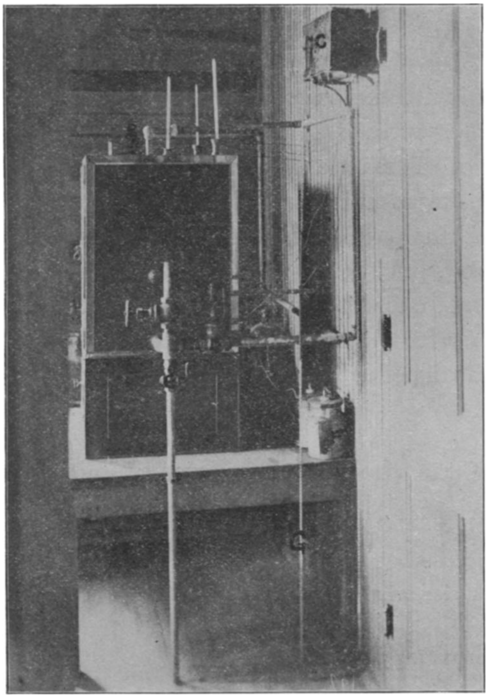


FIG. 5.

THE THERMOSTAT.

The thermostat may be of any of the existing patterns. The one which we use consists of an expanding bar made of hard rubber and brass, firmly bound together and pivoted at one end, the other end being free to move in either direction, making contact with a binding post on either side as the bar expands or contracts. This thermostat is so arranged that both binding posts may be turned to one side for purposes of adjustment. The expanding bar is connected with the batteries and each of the stationary binding posts to the motor.

THE BATTERIES.

Any battery with sufficient power to move the magnet on the escapement of the motor would suffice. We have a two-cell ammonium chloride battery with carbon cylinder.

THE MOTOR.

The motor is a common clock-work motor, such as is used in the regulation of street steam and furnaces. It is set in motion by the lifting of the magnet attached to the escapement, and when so acted on makes a half turn, thus opening the balanced valve by means of chains passing through pulleys between the balanced valve and motor. At the same time, by means of a shunt, the circuit is thrown onto the other binding post of the thermostat and made ready for the opposite contact. The motor is wound each day by means of a key or crank.

COST.

The cost of the whole apparatus was as follows:

Thermostat - - - - - - - -	$ 3.00
Motor - - - - - - - - - -	10.00
Valve - - - - - - - - - -	4.00
Batteries, wire, chains, pulleys, etc. - -	1.95
	$18.95

Charges for piping, extra.

Our apparatus has been installed about three months, and works admirably within limits of 1° C., and might be made to work more closely. It is so adjusted that when the temperature reaches 20°.5 C. the cold water is turned on, and when the temperature falls to 19°.5 C. the cold water is shut off. The temperature graduations of the thermostat are not relied upon, but the temperature is observed from accurately graduated thermometers reading between $-10°$ and $+50°$ C.